Empirical applications of spatial competition; an interpretative literature review

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Abstract

This paper provides a review of the empirical literature on spatial competition, as well as a research agenda for the future. The earlier literature generally finds that firms cluster in product space, under the implicit assumption that consumer preferences are distribute uniformly. More recent literature, aiming at geographical patterns, find that firms cluster where customers cluster. The issue of entry in relation to location choice has come into play only recently and links traditional entry decision theory to spatial competition. The research agenda for the further includes the measurement of the underlying distribution, distance in transport costs when focusing on product space. Furthermore, further research may focus on the specification of the relationship between distance and transport costs, as well as panel data analysis of sequential entry and location choice.

keywords: spatial competition, empirical, entry, product differentiation,

1. Introduction

Why do different brands of beer taste different? Why do cereals come in so many varieties? Why do all the flights leave at 8 am? Some products are greatly diversified, whereas others are very similar. Economists have used Hotelling's analogy of spatial competition (Hotelling, 1929) to understand firms' location choices, both in geographical and in product space. The theoretical model has proven to be a powerful tool to evaluate firm behavior under different assumptions and it seems that almost any outcome can be obtained if the 'right' assumptions are applied. In this respect, it may come as a surprise that empirical applications of the model are of a fairly recent nature. This paper reviews and interprets the empirical literature on spatial competition.

Hotelling (1929) uses location as a metaphor for product characteristics. The location of a firm on Main Street may also be interpreted as the taste of a brand of beer, the amount of fibers in bread or the type of music a radio station plays. The location of individual consumers may reflect their preferences for product characteristics and transport costs are a measure of how bad the consumer feels about not getting exactly what he wants. Firms choose locations in the first stage of the game and compete in prices in the second stage. Two effects play a role in choosing locations, the market stealing effect and the market power effect. The former yields an incentive for a firm to be close to the center of the market, whereas the latter urges firms to locate away from each other.

In his original contribution, Hotelling concluded that both firms locate in the centre of the market, resulting in minimum differentiation. D'Aspremont *et al.* (1979) showed that the minimum location equilibrium does not exist. Assuming quadratic transport cost, they concluded that firms locate at both ends of the market, resulting in maximum differentiation.[1] Anderson *et al.* (1992) introduce consumer heterogeneity as the main factor determining the relative importance of market stealing effect and the market power effect, with the former being dominant if consumer heterogeneity is large.

The debate on minimum versus maximum differentiation literally got an extra dimension when Tabuchi (1994) and Veendorp and Majeed (1995) extended the model to two dimensions. They found that firms maximally differentiate in one dimension and aggregate in the other. For more than two dimensions, Irmen and Thisse (1998) find that firms maximize differentiation in the dominant characteristic and minimize differentiation in the other characteristics. Larralde *et al.* (2009) add consumer heterogeneity to this result and find that firms aggregate for high levels of consumer heterogeneity and differentiate in one dimension for lower values of consumer heterogeneity.

With theory being ambiguous on the question whether firms differentiate or aggregate, empirical research may provide answers. However, the world has not yet been flooded with empirical research into spatial competition. The increasing availability of spatial micro data, computer power and

[1] Tabuchi and Thisse (1995) show that firms locate at (-1/4, 5/4) if firms are allowed to locate outside the market.

geographic information systems has lead to an increasing number of studies by the start of this century. The development of novel estimation techniques has increased the possibilities to empirically model strategic firm decisions (see Draganska et al., 2008 for an excellent overview) from which research in spatial competition also benefits.

The purpose of this paper is to provide a comprehensive and interpretative review of the empirical literature so far and to provide a research agenda for the future.[2] Section 2 discusses the contribution of the empirical literature to the minimum differentiation debate. This is followed by a discussion on the relationship between spatial entry and spatial competition in section 3. We discuss measurement and estimation issues in section 4 and summarize and discuss our findings in the final section of the paper.

2. Minimum versus maximum differentiation

As we discussed in the previous section, the theoretical literature does not answer the question whether special competition results in minimum or maximum differentiation The outcome ultimately depends on the choices made in modeling. Are transport costs linear or quadratic? Is demand elastic or not? Is the market covered? What is the underlying distribution of preferences? Almost any outcome may come from the theoretical model, as long as the 'right' assumptions are fed into the model. This implies that empirics should give the answer. Do firms cluster or do they evade competition?

Earlier empirical applications (e.g. Shaw (1982), Swann (1985) and Hjorth-Andersen (1988)) find that firms cluster in product space. This leaves two questions unanswered however: First, what is the impact of strong spatial concentration of customers, and second, do the firms cluster in all respects?

Earlier studies find evidence of concentration
Shaw (1982) analyzes the placement of products in the UK fertilizer industry. He defines product placement by the product's percentage contents of the three major plant foods and the residual element. He analyzes the products that the three main producers introduce in a period of roughly two decades. Shaw finds the number of different products offered to increase substantially and that a significant proportion of those products does not change over time. Shaw concludes that clusters of minimally differentiated, but not exactly identical, products are offered in market segments with sufficient demand. For smaller niche market segments, firms design isolated products.

Swann (1985) assesses spatial competition patterns in product space for microprocessors and finds two types of clustering; clustering by second source producers and clustering by producers with own designs. Second source production relates to firms copying an existing and successful design, thus saving on designing and development costs. If these savings are substantial, second source producers have no

[2] The paper focuses on strategic decisions for single products. the multiproduct issue will be left for further research.

need to fear for price competition as they are likely to be cost leaders anyway. Swann (1985) also finds that many producers of own design microprocessors followed market leader Intel in terms of product specifications and sequence of introduction.

Hjorth-Andersen (1988) analyzes the verdicts of German consumer testing agency 'Test' on 175 commodities. He develops a cumulative measure of quality scores on characteristics of the goods, thus arriving at a combined indicator for vertical product differentiation. Hjorth-Andersen concludes that most commodities are clustered at the high end side of the market. His results are not explicitly linked to spatial competition model, but there is no strict reason not to. Grunewald *et al.* (1993) repeat the Hjorth-Andersen's analysis with a larger (but similar) dataset and extend it with several more refined indicators, arriving at similar results.

If consumers concentrate, firms concentrate

All the earlier studies find evidence of clustering, but they don't take into account the impact of the locations of customers. Newer studies, especially those looking at geographical clustering, do. Both Netz and Taylor (2002) and Orhun (2005) find that firms cluster where consumers cluster. This makes perfect sense, and is consistent with theoretical results. Neven (1986) finds that for more concentrated distributions of customers, firms will move inside. If the distribution of customers (or preferences) is ignored in an empirical study however, the results may suggest strong concentration of firms, whereas firms in fact just follow their customers. Hjorth-Andersen (1988) finds a high level of aggregation, which is probably due to the strong aggregation of consumer preferences. This implies that spatial concentration of firms has to be considered in the light of spatial concentration of their customers.

An interesting finding in this respect is the one found by Salvanes *et al.* (2005), who study the impact of deregulation and entry on civil aviation in Norway. They analyze the departure time location of flights in the Norwegian airline industry following deregulation. Some routes went from monopoly to duopoly after deregulation, whereas some others remained to be served by a single airline. Salvanes *et al.* (2005) find that departure times are clustered more on duopoly routes than on monopoly routes, and conclude that freedom of choice decreases trough entry. This finding is fairly similar to Borenstein and Netz (1999), who find a negative relation between competition and departure time differentiation.

It has to be noted though, that both Salvanes *et al.* (2005) and Borenstein and Netz (1999) do not correct for the possibility of concentrated passenger preferences with respect to time of day. If preferences are concentrated, as acknowledged in this case by Borenstein and Netz (1999)[3], the interpretation changes. In a duopoly market, firms have stronger incentives to adjust to consumer preferences than in a monopoly market, hence the movement observed by Salvanes *et al.* (2005) merely reflects that firms cluster where consumers cluster. This interpretation is consistent with remarks made by Borenstein and Netz (1999) that their results also suggest that an increase in logistical flexibility as well as high capacity utilization are associated with an increase in departure time differentiation.

[3] Empirical results by Lijesen (2006) also suggest that departure time preferences are not distributed uniformly over the day.

Salvanes *et al.* (2005) also find that the concentration effect is stronger in the business traveler segment than in general. This finding, and their observation that price competition is less fierce in the business traveler segment, leads them to the conclusion that more price competition results in less clustering. However logical this may seem, an alternative interpretation is equally likely. If business travelers have relatively strong or relatively concentrated preferences for departure times, firms serving this segment are more likely to concentrate their output. Moreover, most airlines rely heavily on business travelers to make a profit and hence have a strong incentive to cater to their needs.

In empirical studies relating to competition in geographical space rather than product space, the location of customers is taken into account in more detail. Recent improvements in the availability of geographical data and increased computer power allow researchers to take the location of consumers into account. Netz and Taylor (2002) find that firms spatially differentiate when competition increases. If demand is dense however, suppliers tend to differentiate less, as in their case of gasoline stations near major roads. Similarly, Zhu and Sing (2009) find that discount retailer chains Wal-Mart, Kmart and Target locate their outlets near concentrations of consumers, but not too close to their competitors. Also note that competitive interactions between the chains is asymmetric; the impact of Kmart on Wal-Mart is larger than the other way around. Furthermore, Wal-Mart's supercenter format excerpts its competitive influence over a larger distance.

Seim (2006) finds location to be the main source of product differentiation in the video rental industry. Her results clearly point in the direction of maximum differentiation once the location of demand is taken into account. Picone *et al.* (2009) provide a striking illustration of the impact of demand density on firm concentration. They find that public schools cluster more than one would expect from random location choice. Since there are no market forces at work here, other factors, such as demand, zoning and geography, are bound to cause the clustering. If this holds for public schools, it's likely to hold for market sectors too. Picone *et al*. (2009) argue that the strategic nature of clustering has to be assessed by comparing markets with similar spatial concentration of demand and location limits. Following this line of reason, they find that liquor stores cluster less than offsite sellers, whereas restaurants and bars concentrate more.

For studies that focus on product space rather than on geographical space, such as Borenstein and Netz (1999), taking consumer concentration into account is a challenge, as it requires detailed information on the distribution of consumer preferences. Recent developments in the fields of discrete choice analysis, such as the mixed logit model (e.g. Green *et al.*, 2006) yield room for tackling this issue. Future research could focus on establishing the link between the distribution of consumer preferences and spatial competition in the product space.

Spatial competition in multiple dimensions

The other question, whether firms cluster in all respects, relates to a relatively new theoretical finding. Irmen and Thisse (1998) establish that firms tend to maximize differentiation in one characteristic and minimize differentiation in others. So, if firms differentiate in product space, we would probably observe

them to minimize differentiation in geographical space. Several recent empirical studies have confirmed this finding. Einav (2009) and Freeman and Kosova (2009) are recent examples of studies confirming that finding. In both studies, the measurement of locations in product space if still fairly crude, implying that they can't provide the ultimate empirical proof of the theoretical finding of Irmen and Thisse (1998).

The finding by Picone *et al*. (2009) that liquor stores cluster less than offsite sellers, whereas restaurants and bars concentrate more, may also be viewed in this light. Bars and especially restaurants are more likely to offer differentiated products than liquor stores, which is in line with their result.[4]

The only study to our knowledge that does not confirm the theoretical finding is the one by Netz and Taylor (2002). They find that firms increase geographical differentiation when differentiation in product space is larger. Watson (2009) looks at the issue from a slightly different angle. He finds that the average per firm variety in the retail market for eye glasses decreases as the number of rivals increases. This may seem to contradict the theoretical result at first glance, but it means in fact that firms focus on smaller market segments, hence specialize. This means that they increase distances in product space if distances in geographical space grow smaller, because in the case of eye glasses retailers, the costs of relocating in product space are probably lower than the costs of relocating in geographical space.

3. Spatial entry and spatial competition

Spatial entry relates to the decision of location choice for entrants. The seminal paper on the subject, by Bresnahan and Reiss (1991), modeled entry decision in an isolated region, given the presence of competitors. Relaxing the assumption of isolation and zooming in on ever smaller regions, the relation with spatial competition becomes evident. Spatial competition and spatial entry are related in several ways. First of all, and closest to Bresnahan and Reiss' contribution, firms may only enter if there is room to do so. The second issue follows from the first. Given the fact that all active firms in a market were at one time entrants, their current locations should reflect their entry decisions in the past, rather than follow from a simultaneous game. This is related to the issue of simultaneous versus sequential moves.

Spatial entry

Bresnahan and Reiss (1991) start their analysis by linking the price cost margin of a monopolist to its fixed cost. If the isolated market is small and fixed costs are just covered, the monopolist makes zero profit and no room for entry exists. If either the price cost margin or the market is larger, there may be room for entry. Firms enter up to the point where the marginal entrant earns a zero profit. If the reduction in the price-cost margin due to entry is stable, this may imply that the market is competitive, but stabilization at any less competitive level can't be ruled out at forehand. Bresnahan and Reiss (1991 apply their model to several local service providers to confirm their theoretical model. Bresnahan and

[4] Note however that bars may also cluster for strategic reasons, i.e. 'bar-hopping'.

Reiss' model focus on entry, and not so much on spatial competition. As they assume (and carefully choose) isolated regions, the firms decide on entry in a specific region rather than at a specific location.

The framework used by Orhun (2005) is consistent with the analysis of Bresnahan and Reis (1991). Following the line of reason that all firms entered the market at some point in time, Orhun estimates a model explaining firm locations within isolated markets from expected profits. Like in the paper of Bresnahan and Reiss, firms will enter if a market is big enough and has sufficiently low competition. Competition however also depends on the spatial distribution of firms within the market, thus introducing spatial competition into the model. Zhu and Singh (2009) use a similar framework.

Seim (2006) uses a similar framework as Orhun (2005), but focuses on simultaneous location and entry decisions. She applies an imperfect information framework to her analysis, stating that firms choose locations based on their expectations of competition in a location. Generally, information on the number of firms considering entry is not available however. Seim (2006) solves this problem by estimating the model for two different assumptions for the number of potential entrants; it is either a fixed number (50, which is more than twice the number of actual entrants in most markets) or twice the actual number of entrants in a market.

Simultaneous versus sequential entry

In their analysis of the location of gasoline stations, Netz and Taylor (2002) distinguish between stations that are present throughout the sample period and stations that have entered during the sample period. This distinction may be useful when market conditions change and locations of incumbents merely reflect entry decisions from a past situation that no longer exists. On the other hand, firms entering a market may lead to other firms exiting on a later date, so that an exclusive focus on entrants may be inappropriate as well. Netz and Taylor (2002) find that their results are robust with respect to these samples, implying that the stable firms generally give a good impression of location choice of entrants. Note however that this implication cannot easily be transferred to other markets.

5. Assumptions and measurement issues

This section turns to the operational issues involved in the empirical studies. We first look at the definition of the dependent variable used, as well as the specification and estimation technique. We then zoom in on how the underlying distribution of customers and their preferences is identified, followed by discussions on the operationalization of distance and a brief comment on transport costs..

Dependent variable, specification and estimation technique

Salvanes *et al.* (2005), who study spatial competition in aviation, construct a so-called cluster index, based on the total waiting time for all flights on a certain route. The index is at its minimum when flights

are spread equally over the day, increases when departure times cluster and decreases in the number of flights per day. Borenstein and Netz (1999) construct a similar indicator, which is at its maximum when flights are spread equally over the day, and does not depend on the number of flights per day. Picone *et al.* (2009), looking at the spatial distribution of liquor selling points, use the nearest neighbor index, indicating the ratio of clustering to the expected clustering when locations are chosen randomly. If the index is below unity, it signifies a tendency to cluster, whereas a value above unity points in the direction of even spacing.

Watson (2009) investigates product diversity in eyeglasses retail, using a count of the number of frames per store and then calculates the mean of the logarithm of that variable at the market level. At the firm store level, the number of frames indicates a lower level of differentiation, but at the market level, it is the other way around, as it implies that firms specialize in certain types of frames.

The focus of Chan *et al.* (2007) is not aimed at measuring the outcome of the location game. Since locations for Gasoline stations in Singapore are chosen by government, their model measures market shares (and profits) of gasoline stations based on station characteristics, price and distance to consumers. This may be interpreted as finding the pay-off of the pricing stage of the game after locations and prices are chosen.

Davis (2006), like Chan *et al*. (2007), zooms in on the outcomes of spatial competition at given locations for movie theaters. Apart from the geographical dimension, Davis crudely takes into account the product space dimension as well, by distinguishing between theatres that play the same movie(s). Davis (2006) estimates a function linking prices to population and theatre and movie characteristics, He models market shares as a function of movie and theatre characteristics, populations (within distance bands) and price and estimates a full model.

Both Orhun (2005) and Zhu and Sing (2009) estimate a model describing the probability of firm i choosing location as a function of its expected profits, which in turn is influenced by demand and the level of spatial competition. Netz and Taylor (2002) construct a measure of spatial differentiation for gasoline stations, defined as "…the average Euclidian distance between the center station and each of its rivals."[5] They construct this measure for different cut-off points (market sizes, half-, one- and two-mile radii) where rivals are no longer considered substitutes. Netz and Taylor (2002) note that spatial autocorrelation may play a role in their specification and solve this problem using a spatial error weighting matrix. Table 1 below provides an overview of the dependent variable, specification and estimation technique by study.

[5] Op. cit., 164

Table 1 *Dependent variable, specification and estimation technique*

Reference	Industry	Dependent variable	Specification	Estimation technique
Product space				
Borenstein and Netz, 1999	Aviation	Spacing of flights over the day	Loglinear	TSLS
Salvanes *et al.*, 2005	Aviation	Cluster index	Loglinear	Weighted least squares
Watson, 2009	Eyeglasses retail	Number of frames	Loglinear	OLS
Geographical space (or both)				
Chan et al., 2007	Gasoline stations	Market share	Multinomial logistic	
Davis, 2006	Movie theatres	Price, market share	Multinomial logit	TSLS/GMM
Netz and Taylor, 2002	Gasoline stations	Average distance between rivals	Linear, with spatial error weighting matrix	Tobit
Orhun, 2005	Supermarkets	Probability of firm presence in grid cell	Multinomial logit	ML
Picone *et al.,* 2009	Liquor stores, offsite sellers, bar and restaurants	Nearest neighbor index	linear	OLS
Seim, 2006	Video rental stores	Probability of firm entry in grid cell	Multinomial logit	ML
Zhu and Sing, 2009	Discount retailing	Probability of firm presence in grid cell	Multinomial logit	ML

Measuring the underlying distribution

As we discussed in section 2, the underlying distribution is important to the measurement of spatial competition, as companies tend to follow customers. Ignoring the underlying distribution bears the risk of drawing the wrong conclusion with respect to clustering. All studies that somehow construct an

aggregate measure of differentiation as dependent variable, implicitly assume that consumers are distributed uniformly over space. Borenstein and Netz (1999) for instance construct a relative measure that reflects how flight departures are spread over the day, defined as the proportion of the maximum differentiation in departure times. Their index ranges from zero to unity, with a value of unity reflecting an even spread of departure times over the day. The construction of such a variable does not require any assumption on the underlying distribution, but the interpretation in terms of the Hotelling model does. As we argued in section 2, firms cluster where consumers cluster. Ignoring the distribution of consumers (or their preferences) then implies the implicit assumption that consumers do not cluster, i.e. are uniformly distributed. A similar line of reason holds for Salvanes *et al.* (2005) and the older studies mentioned in section 2.

Sudies focusing on geographical space often use some measure for market size, such as population (e.g. Chan et al., 2007; Zhu and Sing, 2009; Orhun, 2005; Picone *et al*., 2009; Watson, 2009) or the number of households (e.g. Davis, 2006). Netz and Taylor (2002) use a slightly different indicator for market size. They acknowledge that people or households buy gas from gas stations, but they also note that these customers are mobile and that demand concentrates on busy roads. Apart from mere indicators of size, correction factors can be used if some groups are more likely to buy the product. Income, age and race are commonly found correction factors, alongside more specific indicators for some products.

Some studies acknowledge that location choice is not based on market size and competition alone, but also on local cost factors. Zhu and Sing (2009) use several indicators related to production costs, such as the retail wage level and the distance to the firm's headquarters and nearest distribution centre. They also try to approximate real estate price by house values, but conclude that this is not a good proxy for commercial land value.[6] Alternatively, they use the number of retailers as a proxy to capture the business density at the location. High business densities may be correlated with high commercial land values, but there may also be other reasons to choose a location with a high or low business density. Orhun (2005) adopts a different interpretation for retail density, stating: "A location with very few or no retail establishments is less likely to be chosen, possibly reflecting unobserved zoning rules."[7]

[6] Orhun (2005) uses the upper quartile rent , but the impact of this variable on location choice is insignificant.

[7] *Op. cit.,* page 17.

Seim (2006) finds that for some demand drivers, zoning rules work in the opposite direction. Zoning ordinances often apply to tracts that are home to a college or tracts with a high number of households with children, limiting location choices in those tracts. Table 2 below provides an overview of the way the underlying distributions were taken into account.

Table 2 *Underlying distributions*

Reference	Indicator	Measurement level	Correction factors
Product space			
Borenstein and Netz, 1999	-	24 hours	-
Salvanes *et al.*, 2005	-	24 hours	-
Watson, 2009	population	towns	#malls, #hospitals, #ophthalmologists, race, income, age, #interstates
Geographical space (or both)			
Chan *et al*., 2007	Population	Census tracts	Income, #cars, airport proximity, downtown, highway proximity
Davis, 2006	Households	Census tracts	Age, income, race
Netz and Taylor, 2002	-	Address	Major roads, median income
Orhun. 2005	Population density	Address	Income, retail density
Picone *et al.*, 2009	Population density	ZIP-code	Age, income, race, buildings > 20 units household expenditures by category
Seim, 2006	population		Income
Zhu and Sing, 2009	Population	Census tracts	%child, %no vehicle, income, education

Distance

In a spatial model, distance is obviously important. The measurement of distance in product space is however problematic. Salvanes *et al.* (2005) implicitly use waiting time between flights as a measure for distance between product varieties. Within the construction of their index, the impact of distance is implicitly assumed to be linear and not to differ by direction (i.e. late or early). Although their indicator

is somewhat different, Borenstein and Netz (1999) is of a fairly similar nature. Watson (2009) does not define any 'distance' between frames for eyeglasses.

In studies focusing on geographical space, the distance indicator is obviously the distance in miles or kilometers from one point in space to another. Eucledian distances between coordinates are often used (e.g. Netz and Taylor, 2002; Orhun, 2005; Picone *et al*., 2009). Other studies use more broad distance classes (e.g. Davis, 2006; Zhu and Sing, 2009) or do not report details on the exact measurement of distance. Orhun (2005) uses both Eucledian distances and distance bands, reporting the results separately, whereas Netz and Taylor, (2002) use distance bands as a sensitivity analysis on market size cutoffs. The main aspects of the measurement of distance are summarized in table 3 below.

Table 3 *Distance meausurement*

Reference	Indicator	Measurement level	Market size cutoffs
Product space			
Borenstein and Netz, 1999	Departure times	24 hour day	-
Salvanes *et al.*, 2005	Waiting time	-	-
Watson, 2009	-	-	-
Geographical space			
Chan et al., 2007	Travel distance*	Census tract grids	-
Davis, 2006	5, 10 miles bands	Census tracts	15 miles
Netz and Taylor, 2002	Eucledian distance	Address	0.5; 1; 2 miles
Orhun, 2005	Eucledian distance	Address	
	0.5; 2, >2 miles bands		
Picone *et al.*, 2009	Eucledian distance	Address	ZIP-code
Seim, 2006	Eucledian distance	Census tracts	City plus surrounding area
Zhu and Sing (2009)	2, 10, >10 miles bands	Address	County (smaller for highly urban areas)

*no details reported on measurement

Transport costs

The importance of distance in spatial competition models follows from the fact that consumers undergo transport costs in order to reach a store. The theoretical importance of transport costs is obvious, with the specification of costs (linear versus quadratic) determining the difference between minimum and maxiumum differentiation. The study by Chan *et al.* (2007) is the one of the few to explicitly take into account the trade-off between price and distance, and hence transport costs, as defined in the Hotelling model. Unfortunately, their model does not allow for testing the functional form of this relationship, which is one of the important assumptions influencing the outcomes in theoretical models. Davis explicitly models the functional form of the impact of distance on sales in the full model and finds the marginal costs of travel to be positive, but decreasing in distance.

6. Summary and research agenda

Our review of the empirical literature of spatial competition shows that older studies (published in the 1980s) conclude that firms cluster in product space. These studies do not take into account the underlying distribution of customers and their preferences, or implicitly assume that they are distributed uniformly. In real life, consumers (or their preferences) are not distributed uniformly, Later studies, focusing on the geographical interpretation of spatial competition, find that firms cluster where consumers cluster. The net effect of both firms and consumers clustering is not always clear because the measurement of the underlying distribution in the non-geographical interpretation (i.e. product space) is often troublesome.

Studies that take into account competition in product space and geographical space often use proxies for 'distance' and combine these with actual distances and underlying distributions in geographical space. Findings of these combined studies in majority confirm the theoretical finding that firms differentiate in one dimension and concentrate in the others.

The following items for the research agenda emerge from the current state of the literature. First of all, the product space interpretation of spatial competition still needs quite some work. The measurement of the underlying distribution of preferences can be improved, mainly by applying mixed logit techniques that are capable of assessing distributions of preferences. Moreover, defining and assessing both distance and transport costs in product space is also a challenge in product space. Distance and transport costs can probably not be measured separately, but depending on the purpose of the analysis, this doesn't have to be a problem.

If transport costs and distance can be measured separately though, whether in geographical space or product space, further research may focus on the specification of the relationship between them. This is one of the key assumptions leading to opposite outcomes in the theoretical models of spatial competition. One final point to be mentioned for the research agenda is issue of simultaneous versus sequential entry. The issue may also be interpreted in terms of relocation costs. If entry is sequential

and relocation costs are absent, the outcome will be equivalent to those of simultaneous entry. If relocation is costly however, the outcome will represent the theoretical one of sequential entry. With the availability of more data, increased computer power and advanced panel data estimation techniques, empirical estimation of the process of sequential entry (which is the only option in real life) could shed more light on these issues.

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